HOUSE PLANNING HELP

Episode 181

Improving acoustics, noise control and soundproofing with Jack Harvie-Clark

The show notes: www.houseplanninghelp.com/181

Intro: Although an acoustics expert might not be the first person you consult for your self-build project, there are many aspects of construction where noise and noise control can make a difference to your comfort. We spoke to Jack Harvie-Clark from Apex Acoustics about challenges associated with acoustics in the home. I started by asking him for a little bit of background about why he likes working in this area.

Jack: I started my career in the industrial field for a company that makes steam turbines and generators for power stations, doing fluid mechanics and thermodynamics, looking at steam turbine blade design. That was a very old-fashioned engineering company so I didn't last there too long.

I did my two years graduate training and started a job there, and then I looked for something else, did a few other things, did a little bit of work in building science, by chance a post-doc position in the university, and then started working for some mechanical engineers who did consultancy, basically, to the power generation industry.

People kept asking about acoustics and so they reluctantly did it, but they were very good at it, which is why people kept asking them. But they preferred working in the industrial field than in the construction sector.

I liked the construction sector. I enjoyed the challenges of builders ringing up and saying, 'can you come in here and tell me what to do?' They don't care about any theory whatsoever, it's 'how do I build this wall?' And 'how do I build this floor?'

It was at a time of great growth in the acoustics field, because of the Building Regulations that changed in 2003. So there were a lot of opportunities then to work in acoustics. So it just caught my attention. Then I set up myself in 2006.

Ben: Let's start on an overview. What is acoustics as a discipline?

Jack: That's a very broad question.

The Institution of Acoustics is the home, if you like, for people working in acoustics in a broad sense, and that covers everything from underwater acoustics, where most of the money has been for military applications in the past because that pays for things, to acoustics of buildings which is obviously what we're interested in, to how noise affects people's health, noise at work.

Sound is just vibration in the air. So when sound travels through structures, it is vibration in the structure. So it is really about how things vibrate in the world. And we perceive that vibration through the sound, whether that comes through the air or whether it comes through building structures and is re-radiated as sound. It's like an underground train. The vibrations are transmitted through the ground and then the building effectively acts as the loudspeaker.

Ben: What is it that really ends up getting you called in? Is it the client or is it actually just thinking well, we know that this will cause us some sound issues?

Jack: People very rarely call us because they want to make things better. They call us because there's a Building Regulation or a planning condition that they need to comply with and they can't take the risk of doing it without some competent assistance.

Ben: What are these Building Regulations, if they're not too technical? What have you got to adhere to?

Jack: They are the ones that changed in 2003, the last time. They're mostly concerned with sound insulation between attached dwellings. So, airborne sounds through walls and floors and impact sounds through floors between flats. That's most of the purpose of them.

There's also a small part of the regulations that say how you have to build walls that are around bedrooms or rooms that contain a toilet, but that's just a laboratory performance standard. There's no guarantee of sound insulation in a building between those places.

Then there's another part entirely about acoustics of schools.

Ben: Sticking with the houses then, is it really about the materials that you're picking? Because a lot of sound can get absorbed, can't it? If you were building, say, a straw bale house, then I'm assuming you wouldn't have too many problems.

Jack: When you say sounds absorbed, there are two concepts that it's important to distinguish between. One is sound insulation between two spaces, that's how you stop the sound transmitting from one room to another room and we call that sound insulation; the other is sound absorption, which is within a room. So, how quickly does the sound within a room get absorbed?

Your ears know immediately when you're in an enclosed space like a room, rather than outside. Outside you might hear reflections of buildings or structures nearby, but most of the sound is what you would call free-field and it just dissipates. It travels past you and keeps going, it doesn't come back again.

When you're in a room, you hear the reflections. You hear many, many reflections and in fact, the reflections account for much, much more of the sound level than the direct sound when you're in a room. So, that's the field of room acoustics.

Ben: How would we make sure that we don't get this reverberation? I'm assuming there are very few cases where you actually want it?

Jack: Well, actually a little bit is very useful because it adds volume to your voice. That's one of the big challenges in outdoor theatre venues, how do you get enough volume? That's why you have reflectors and things behind the actors, to reflect more of the sound back towards the audience.

So, a little bit of reverberation is useful for increasing the volume, but too much, as you know, if you're in an echoey space, how difficult is it to hear in a train station? That's still a problem that the best people are struggling with, to make announcements audible in a train station, because all of the reflections make it so difficult.

Ben: What then would we need to do? This whole episode came about by someone very concerned, building a house and wanted to understand firstly the acoustics between the inside and the outside of the building. So, making sure, if they're on a busy road for example, they're not going to get any of that noise, and then secondly, between the individual rooms.

Jack: So that first question of keeping external environmental noise out would normally be picked up by the planning department, and there'd be a planning condition that you would have to comply with.

That's when people would give us a ring and say 'how do I do it?' We would go along and measure the noise level outside, look at the plans for the building and say 'with windows this size and your ventilation system like this, you would need to have this type of

glass and this type of treatment for the ventilation.' So you stop the noise getting in, to keep it to the levels that the planning authority will require inside.

They're essentially referring back to World Health Organisation standards. That's noise levels in bedrooms that won't interfere with your sleep and in living rooms, which will mean that you won't have any cause for annoyance whatsoever. So, very good noise levels. They're noise levels that are quiet enough that they won't interfere with whatever you want to do inside.

Sound insulation between rooms is something, as I mentioned before, that's covered in a small way by requirement E3 of the Building Regulations, but that just specifies a laboratory standard that you have to build your walls to. And it only applies to walls between bedrooms and other parts of the dwelling, and rooms that contain a toilet. It doesn't apply to the wall that contains the door.

You just have to use a type of partition that's been tested in the laboratory to achieve a 40 dB sound reduction. But there's no requirement or regulation to build it in any particular way. So if you have a hole in it, that's up to you. The wall will still comply with the Building Regs. So the Building Regs don't ensure any particular level of sound insulation to rooms that might be sensitive from other rooms within your house.

Ben: You've mentioned in there, ventilation systems. I want to come on to that in a second. But perhaps it would be a good idea to have an example that in my new house, I'm going to be doing what I'm doing now which is recording an interview, perhaps over Skype, then my kids might be in another room. Hopefully I will have designed it so that there'll be at least two sets of doors to stop sound going that way. It is going to be a Passivhaus so that's a complication but maybe we can put that aside.

Is there anything else actually in the design of the room that we could do?

Jack: In the design of the room? So, you've already mentioned the key thing. You've noticed that the door is going to be the weak spot for sound transmission and as you note, if you have a Passivhaus, then you will be expecting some ventilation. You'll have the supply ventilation in the living rooms and the extract ventilation from the wet rooms, the bathroom and the kitchen.

So you'll need some undercuts underneath the doors to make sure that the air can travel from out of the room, if it's not a wet room,

when the door's shut. But obviously, an acoustic door would work much better if it has an acoustic seal on the bottom. Otherwise, it doesn't matter how good the performance of the door is, there's more noise going to go through the gap at the bottom than through the rest of the wall and the door put together. So, that's something that you may need to consider.

You could then include, if you wanted to make it more sound insulated, a vent that had an attenuator in it, much like the attenuator in your car exhaust. So, it would let the air through but not the sound. That would be one way of overcoming that, if you wanted your interview room to be well soundproofed.

The other question is about the sound within the room. In an interview room, you want it to be very, very dead. So, you want very little reverberation. People often do things like put carpet on the walls or things like that. So, as much soft furnishings as you can, basically, to provide as much sound absorption as you can practically get in there.

Ben: Let's move this on a little bit. We've talked about internal sound insulation. What about in specific strange circumstances, for example, if we have different height spaces?

Jack: Rooms that have higher ceilings or have larger volumes are naturally more reverberant. And this is because the sound takes longer to travel from the source, to get reflected back to you, so that if it's only absorbed at the same rate, the sound essentially bounces around the room for longer than it does in a smaller room.

This means it's more important to have sound absorption in there. So you know if you get a few people in there, then very quickly the noise level will increase dramatically. Whereas if you have more sound absorption in there, the level of noise will increase much more slowly as you put more people and have more people talking in there.

So, especially if you have children, it'll feel very noisy in a very echoey room and it'll be much more comfortable with more sound absorption in there for everybody.

Ben: How do you work with a building team? You mentioned right at the beginning how you get called in, but what's that process like and when might it happen?

Jack: We would always say we get brought in too late.

Ben: Everyone says that.

Jack: Yeah. Because people resist employing consultants, which there's probably some sense in because you don't want to build your whole house around the acoustics. But getting the timing right is quite difficult, obviously. So, that's where hopefully an experienced architect will give you good advice. But again, architects are reluctant to use us.

So it would really only be if the client was insistent that they were concerned about the acoustics enough, that would make the architect think they didn't want to take the risk of telling the client that the acoustics would all be alright. And at that stage, they might give us a call or suggest the client gives us a call.

Sometimes we get very limited briefs, even on expensive houses. So we're looking at one that's £20 million at the minute and they say they're happy with the walls and floors, they just want to know about how the ducts go through the walls and floors. They're the only bits they want us to look at.

So we do get asked to look at very small bits of very big projects where you might think, or I would certainly think, if it was my house, I would want someone like me to look in more detail over more of it than that.

Ben: You mentioned in there ventilation systems. So, what considerations do we need for ventilation systems?

Jack: Obviously, the only purpose maybe of a ventilation system is to deliver and extract the air. So that's what it's primarily designed around. And noise, if you like, is an adverse effect that might come with it.

Where people have designed passive houses that are going to be certified, they'll probably use a ventilation supplier who is experienced in Passivhaus, and they will almost certainly take care of the noise issues. And that's because there's also a noise standard in Passivhaus, for noise levels not to exceed 25 dB(A) in living spaces and 35 dB(A) in bathrooms. With those noise levels, you're very unlikely to be annoyed by the noise.

If your building is not certified Passivhaus, then there is some reference in Part F of the Building Regulations, and that's the part that deals with ventilation, suggesting that noise from ventilation systems shouldn't be more than 30 dB(A) in bedrooms and living rooms, but nobody enforces that. Because the text in the approved document is a reference to another document, there is some debate

whether it's actually part of the technical guidance of Part F in itself, in any case.

So that means because nobody's enforcing noise levels from ventilation systems, nobody's designing to achieve anything in particular. And this is a big, big problem in this country at the minute because about 30% of new houses have continuous mechanical extract, and 30% have mechanical extract with heat recovery, which means you have supply ventilation back into the living rooms, but nobody is checking or designing the noise levels from these systems.

So although they're meant to be commissioned on the airflow rates, it's not uncommon at all for people to turn the fan down until they think the noise isn't too bad, which then means, obviously, you're not getting enough air.

I can't stress enough how important it is to make sure that your ventilation system will deliver the air you need and the air that you want, which might be two different things, whilst the noise levels – and I think the Passivhaus standard of 25 dB(A) is a very good one – and our experience in other areas suggests that that's very, very unlikely to give anybody a problem with the noise. If you let it go up to 30 dB(A) then there may be some people who will be annoyed by it and will turn it down.

Ben: In your experience then, when you see a certified building, have you ever heard the ventilation system or have been called in because there is noise from the ventilation system?

Jack: In a certified Passivhaus, no. We've been to measure it a couple of times, but even that's pretty difficult because it is so quiet.

So, you have to make sure nobody in the house is making any noise whatsoever, you yourself have to be totally still and make sure your breathing is quiet so that you can hear it.

Ben: Are there any other issues with mechanical ventilation systems and acoustics?

Jack: Another aspect of the system is that sometimes people have trouble where noise can go through the ventilation ducts and travel from one room to another. Sometimes you can hear people in other rooms that you might not want to hear because of noise through the ducts. And again, this is just an absence of design. You should always have crosstalk attenuators on the ducts and then you won't have that problem.

Ben: Is there anything we need to input with when it comes to this design? Because I'm not going to know about what the MVHR design should be. But how do I know, to critique it?

Jack: If the client gives a performance standard for noise levels from the ventilation system, that should be enough. And then at the end of the day, that should be taken account of in the design by whoever designs it.

What happens at the minute, all too often unfortunately, is that the systems aren't properly designed, they're not procured very carefully, they're installed badly. I'm talking about mainstream housing now rather than your self-builder's house. Often the filters are all dirty by the time the house is handed over because the system's been running when the builder's done the final clean. And there's almost no aftermarket for filters. So, everybody knows that nobody is changing these filters every three or six months as they're supposed to.

It's really common as well that residents don't even know they're supposed to change the filters. Some people don't even know they have a ventilation system that's running at all.

Ben: Well, I guess as well you don't know how quickly these houses are turning around, and unless everyone's had good training, it's not something you need to deal with on a day-to-day basis. It's only when you have issues, isn't it?

Jack: That's right, yeah. And there's some interesting research from a couple of years ago that came out of Canada, that shows that actually, people prefer opening windows. They prefer that control over their internal environment.

One of the reasons we've gone down more mechanical ventilation systems is to meet the energy performance requirements of new houses, because obviously, it's more energy efficient to provide ventilation mechanically, then you just provide as much as you need and you can get the heat out of it in winter.

The problem is when people turn their ventilation systems off. In modern houses that are very airtight, you don't get enough ventilation at all and then you get very poor air quality, mould growth and all sorts of problems. It impacts on people's health very quickly.

There's been some stuff in the press about blaming modern airtight, energy efficient houses for this problem but it's obviously not the

houses problem, it's the inadequate ventilation system that is the problem.

Ben: So, keeping the ventilation system on at all times is the way to go?

Jack: Certainly, through the winter. Unless you use opening windows in the summer, then yes. You need it all the time you're not using opening windows.

Ben: There can be acoustic issues with opening windows, can't there?

Jack: Yes. So, if you're in one of those places that's affected by outdoor noise, then you might be reluctant to open your windows because of the noise levels outside. That's something that you then definitely want to take account of in the design, whether or not the planning department make you respond to them in some way.

Another associated aspect of that, that nobody's controlling at the minute, is to do with overheating. Because opening windows is the default method for mitigating overheating, by providing additional ventilation. But at the minute, nobody's assessing whether you're going to have trouble with noise when you're doing that.

So, that's something that you should bear in mind if you're building in a noisy place. Not just how you provide the ventilation but how you control overheating as well.

Ben: Just as we get towards the end and start to wrap up a bit, I know also designing sound systems can sometimes come into your work. What do you do with that and how would you get involved?

Jack: Our particular work is more about how the room responds to the sound. But obviously, in a new house, you're going to want a sound system so it's worth putting the wires in for that, planning where they're going to go as part of the electrical works, so that you don't come and dig more holes in the walls and put them in afterwards.

Placement of speakers can be very important. If you're a bit of an audiophile and care very much about how your audio system sounds, then speaker placement is actually very important, as much as the shape of the room.

Ben: You mention sometimes about being brought in to jobs where you'll just do one thing. Are you ever brought in just for the sound system almost, because they want it to sound really, really good?

Jack: We've never had a job like that yet. It's very rare that people ask us because they want something to sound better. And in fact, they're very difficult questions to answer.

We get asked quite a lot by people who have got a noisy neighbour, what can they do. There's two parts of the answer to that. One is finding out whether there's a problem with the wall that can be rectified, and if the wall is performing as well as it can be for what it is, so there are no defects in it, then the next part of the answer then is how good do you want the sound insulation to be, how much space are you prepared to lose and how much money do you want to spend?

Which obviously, they can't answer those questions. So, how do you give someone a solution to something when they can't really describe how good they want it to be?

So, part of our job is interpreting what people want when they say things. When they say they want it to be silent, then we have to interpret that.

Ben: How might that follow forwards? Would you have a big amount of work needing to be done or is it really just taking it down to that limit where it's acceptable now?

Jack: Yeah. We would judge what might be suitable for someone when they say they want to hear no noise whatsoever from next door. You might think maybe they want it to be 10 dB quieter or 20 dB quieter. And then we'll suggest the sorts of things they would need to build to achieve that.

Ben: Have we covered all the common questions that you might get around about housing?

Jack: Yes, I think so. There are some other issues with things like air source heat pumps. That's a new noise source which people have outside their dwellings. That can cause issues for the neighbours and that's not particularly well controlled through the planning system at the minute.

Ben: As we finish up then, what are the key headlines that we should think about as a self-builder from this conversation?

Jack: I think the ventilation system is something that everybody will have to some extent. So, whether that's just extract ventilation from the bathroom or supply and extract, if it's an MVHR system. So, getting the acoustics right from that, everyone should put some attention to that.

And that can start with just a specification for noise that means the builder has to achieve something or the designer has to achieve something from that, which means that it will then get taken care of in the design.

The next most important thing, I think, is that issue of noise from bathrooms, through floors, through walls, to rooms where you don't necessarily want to hear people in the toilet. And after that, it's more room acoustics. How good do you want it to be? Do you care? Have you ever had any problems before that you want to make sure you don't have in this house? Or has it been alright and so it's fine?

Ben: Jack, really appreciate your time. Thank you very much.

Jack: Thanks Ben.